A toy building set with a vibrator and a vibration sensor

The invention relates to a building set with building elements that have coupling means for interconnection of building elements.

Such building sets are known eg in the form of toy building sets for children and the following patent publications are examples of such: US 3 005 282, US 5 984 756 and P 490 033 showing toy building elements with various coupling means for interconnection of building elements, and toy building sets with other coupling means are known. These and other prior art building sets are used primarily as toys for children, but also for the construction of models of buildings and machinery.

The toy building set as described in the above patent publications area also available with movable elements, such as motors and wheels, and with other functional elements of which some are able to generate audible sound. In neither of these publications the vibrations are used to advantage for mechanical purposes.

It is an object of the invention to provide a building set for use as toy and for teaching purposes, and whereby it is possible to build models with novel functions that are useful – both when used for toys and when used for the construction of models for teaching purposes, where it is possible to build illustrative models for demonstrating the influence of vibrations on static and dynamic structures.

This object is accomplished with a building set according to the invention comprising a vibrator building element with a device for generating vibrations and having coupling means for interconnection with the remaining building elements of the building set.

By such building set it is possible to build structures and models, wherein the vibrator building element can be arranged in various places in the structure. Depending on the size of the structure, its rigidity, etc, and the nature of the vibrations, such as intensity and frequency, the vibrations will influence the structure in different ways. In case of relatively powerful vibrations, the structure will be caused to move across its support, and different positions of the vibrator building element on the structure will result in different movement patterns and, likewise, constructions of different sizes and rigidities will react differently to vibrations. Moreover, when one touches the structure with one's hand or finger, one will experience a sensory impression of the intensity of the vibrations.

By a building set that also comprises a sensor building element with a vibration sensor configured for emitting signals representing vibrations and with coupling means for interconnection with the remaining building elements of the building set, it is possible to obtain signals for objective measurements and registrations of vibrations in structures built with the building set for illustrating the propagation of vibrations through solid structures. Thus, the building set can be used both as toy and for teaching purposes. The sensor building element may be configured for emitting signals that represent vibration rate or vibration acceleration.

The configuration of the vibrator building element for generating vibrations may conveniently comprise a motor with a rotatable shaft and an eccentric mass on the shaft that will generate two-dimensional vibrations, or a magnetisable mass and an electric solenoid for magnetic cooperation with the magnetisable mass that will generate one-dimensional vibrations. Preferably the motor is an electromotor, but it is also an option to use a purely mechanical motor that is driven by a spring that can be wound or by a flywheel that the user may cause to rotate.

The building set may also comprise a building element with two mutually movable parts that each has coupling means for interconnection with the remaining building elements of the building set, and which are mutually connected by means of a flexible element. Such element can be arranged as a vibration deadening or absorbing element in the structure, and the user may experiment with the effects it has.

Brief description of the drawing

Figure 1 shows a known toy building element, seen in a perspective view from above and below, respectively;

Figure 2 shows a further known toy building element, seen in a perspective view from above and below, respectively;

Figure 3 shows building elements in a prior art toy building system;

Figures 4A and 4B show a vibrator building element according to the invention;

Figure 5 shows a flexible building element for use in a building set according to the invention;

Figures 6A and 6B show an alternative vibrator building element according to the invention;

Figure 7 shows a third vibrator building element according to the invention;

Figure 8 is a schematic view of a structure built by means of a building set according to the invention;

Figure 9 is a schematic view of an alternative structure built by means of a building set according to the invention;

Figure 10 shows a principle of how to use vibrations to advantage to create a net linear movement;

Figure 11 shows a variety of the principle shown in Figure 10; and

Figure 12 shows a principle for using vibrations to advantage to create a net rotating movement.

Detailed description of the invention

Figure 1 shows an example of the type of building elements that are known from US 3 005 282. The building element has vertical sidewalls and a top wall with coupling means in the form of cylindrical protrusions or studs. The element has a downwardly open cavity, and centrally in the cavity there is a coupling means in the form of a tubular element that is in permanent connection with the top wall. Such building elements are available in many sizes and with varying numbers of coupling studs. When they are to be interconnected, the building elements shown in Figure 1 can be built on top of each other, whereby coupling studs on an element are received in the cavity of another element.

Figure 2 shows examples of other prior art building elements that share essential characteristics with the building elements shown in Figure 1. Moreover, on their coupling means, the building elements shown in Figure 2 have electric contact faces of a conductive material.

On their top faces the coupling means thus have contact faces of metal on a part of their cylindrical faces; and two of the four walls that define the cavity

of the element have corresponding contact faces of metal in those places that will, upon interconnection with other elements, be in contact with the contact faces on their coupling studs. Such interconnected elements are able to transmit electric power and electric signals.

Figure 3 shows a third type of known building elements that use the same coupling principle as the building elements shown in Figures 1 and 2. Moreover, the through-going cylindrical openings are able to receive bushing joints by which two building elements can be joined next to each other. At its ends, the elongate building element has coupling means that are known from the above-referenced US 5 984 756.

The prior art building elements are mere examples of building sets for which the invention lends itself for use. In the following the invention will be described and exemplified by use of the prior art building elements shown in Figures 1 and 2.

Figures 4A and 4B show a building element 10 with coupling means of the same type as in Figures 1 and 2, wherein cylindrical coupling studs 11 on the top face are shown. The building element 10 contains an electromotor 12 carrying on its rotatable shaft 13 and eccentric mass 14. The electromotor 12 and the eccentric mass 14 is entirely contained in the building element 10, and the motor 12 is provided with electric power, eg through an electric wire or through electric contact faces, like in the building element shown in Figure 2.

Figures 6A and 6b show a building element 15, wherein the electromotor 12 is built integrally with the building element 15, whereby the shaft 13 of the motor extends beyond the building element 15. In a manner similar to that of Figures 4A and 4B, the shaft 13 carries the eccentric mass 14, with the sole difference that the eccentric mass 14 is outside the building element 15.

When the motor in Figures 4A, 4B, 6A and 6B rotates, the eccentric mass 14 with its imbalance will bring about the generation of correspondingly rotating forces that will result in vibrations.

Figure 7 shows a building element 16 that contains a vibrator with an electric solenoid 17 and a magnetisable mass 18 that is mounted flexibly in the building element 16. When alternating current of a suitable frequency and amplitude is supplied to the solenoid, the solenoid will in a known manner cooperate magnetically with the magnetisable mass 18, and thereby oscillating forces corresponding to the alternating current will be transmitted to the building element 16 will then be caused to vibrate correspondingly. In principle, these vibrations are one-dimensional, linear vibrations.

Figure 5 shows a building element 20 with two mutually movable parts 20A and 20B that each has coupling means for interconnection with the remaining building elements of the building set, and that are mutually connected by means of a flexible element, herein two springs 21. Such building element is known from EP 560 843.

Figure 8 schematically exemplifies a structure built by means of a building set according to the invention. In this structure, a number of prior art building elements as shown in Figure 1 partake. On top of these prior art building elements there is a vibrator building element 10 like in Figures 4A and 4B. The motor 1 in the vibrator building element is provided with electric power from a power supply 22, either through a separate wire or by means of building elements like in Figure 2.

Figure 8 also shows a sensor building element 23 that features a vibration sensor configured for emitting electric signals representing vibrations; and coupling means for interconnection with the remaining building elements of

the building set. The vibration sensor can be configured in accordance with the same principle as the vibrator building element shown in Figure 7; and when the sensor building element is caused to vibrate, the magnetisable mass will move in relation to the solenoid, whereby an electric signal is generated in the solenoid, which signal is proportionate to the rate of the vibrations. Alternatively the vibration sensor may be an accelerometer that emits a signal which is proportionate to the acceleration of the vibrations.

The electric signals from the sensor building element 23 are conveyed to an analyser or a measurement instrument 24 configured for indicating or measuring the amplitude of the vibration signals or optionally analysing these signals.

In the shown configuration, vibrations from the vibrator building element 10 will be transmitted through the structure to the sensor building element 23, and the measurement instrument 24 will indicate the amplitude of the transmitted vibrations.

Figure 9 shows the same structure as figure 8, wherein, however, the vibrator building element 15 is used and has been turned 90 degrees in relation to Figure 8, and moreover the building element 20 shown in Figure 5 is arranged between the vibrator building element 15 and the remaining structure. With its springs the building element 20 serves as vibration deadening element.

Figure 10 shows a building element 25 having bristles 26 on its underside that all face essentially in the same direction that forms an angle different from zero degrees to the normal in relation to the surface, and that are hence not perpendicular to the bottom of the building element, but are all inclining. The bristles may be made of hair or fibres of natural materials, such as plant fibres or metal threads, or artificial materials, such as plastics fibres. Herein,

the vibrator building element 16 is interconnected with such building element 25 that is supported on a support 27. When the vibrator building element 16 vibrates, it will cooperate with the inclining bristles and cause the vibrator element 16 to move in the direction of the bristle orientation, ie to the right. In Figure 10 the vibrator building element is configured for vibrating in the horizontal direction, but the same effect is accomplished with vibrations in the vertical direction.

Figure 11 shows a support 27 having bristles 28 on its top face that are not perpendicular to the underside of the support, but rather, in a manner similar to the one shown in Figure 10, they are all inclining. A structure 29 of a number of interconnected building elements rests on top of the bristles 28. The support 27 with the bristles 28 vibrate in vertical direction, and by these vibrations, too, the structure 29 will cooperate with the inclining bristles to the effect that the structure 29 will move in the direction of the bristle orientation, ie to the right. The same effect is accomplished if the support 27 with bristles 28 vibrates in horizontal direction.

In Figures 10 and 11 it is in principle of no consequence whether it is an element provided with bristles or the element without the bristles that vibrates, and whether the vibrations have a vertical orientation or a horizontal direction. The resulting movement is determined by the direction of the bristles in relation to the normal of the outer surface that carries the bristles.

Figure 12 shows the vibrator building element 16 interconnected with a building element 30 as a part of a larger structure, which is not shown. Figure 12 also shows a wheel 31, which is also a part of a larger structure. The building element 30 is arranged such that its one end touches the periphery of the wheel 31. When the vibrator building element 16 vibrates in horizontal direction as shown, ie approximately in the tangential direction of the wheel in the point of contact thereof, the wheel will rotate. This effect relies on the

building element 30 transferring, in the contact point, different forces in the two directions for the vibration movement. .This rotation can be used to advantage for operating mechanisms in the structure.